THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

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1. A method of forming a material capable of being applied to a surface, the method including the steps of:

(a) providing precursors capable of reacting to form a gel;

(b) reacting the precursors together to form the gel;

(c) adding a particulate material to the gel to form a mixture, the particulate material being capable of chemically bonding with the gel; and

(d) treating the mixture such that a modified gel is formed in which the particulate material is bound to the gel, and the modified gel is capable of forming a surface which is chemically hydrophobic and has a surface roughness which physically enhances the surface hydrophobicity, such that water has a contact angle on the surface of at least 150°.

2. The method according to claim 1 wherein the modified gel is capable of forming a hydrophobic surface on which water has a contact angle of at least 155°.

3. The method according to either claim 1 or claim 2 wherein the modified gel is capable of forming a hydrophobic surface on which water has a contact angle of at least 160°.

4. The method according to any one of the preceding claims wherein the modified gel is capable of forming a hydrophobic surface on which water has a contact angle of at least 165°.

5. The method according to any one of the preceding claims wherein the precursors provided in step (a) include at least water, a solvent, and a metal alkoxide.

6. The method according to claim 5 wherein the solvent

comprises an alcohol.

7. The method according to claim 6 wherein the alcohol is selected from the following group:
methanol;
ethanol;
isopropanol;
and butanol.

8. The method according to claim 5 wherein the solvent is selected from a group comprising: hexane; and diethyl ether.

9. The method according to any one of claims 5-8 wherein the metal alkoxide is selected from the following group:
tetramethoxysilane;
tetraethoxysilane;
titanium tetraisopropoxide;
titanium tetramethoxide;
titanium tetraethoxide;
titanium tetrabutoxide;
zirconium n-butoxide.

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10. The method according to any one of the preceding claims wherein step (b) of reacting the precursors together comprises refluxing the precursors for an extended period.

11. The method according to any one of the preceding claims wherein the particulate material comprises particles having substantially equal diameters.

12. The method according to any one of claims 1-10 wherein the particulate material comprises particles having a spectrum of diameters.

13. The method according to either claim 11 or claim 12 wherein at least some of the particles have diameters within a range from 1 nanometer to 1 micrometer.

14. The method according to either claim 11 or claim 12 wherein at least some of the particles have diameters within a range from 1 nanometer to 100 nanometers.

15. The method according to claim 11 wherein substantially all particles have diameters within a range from 1 nanometer to 500 micrometers.

16. The method according to either claim 11 or claim 12 wherein the particles have a primary particle diameter in a range from 5 nanometers to 50 nanometers.

17. The method according to either claim 11 or claim 12 wherein the particles have an average particle size in a range from 5 nanometers to 20 nanometers.

18. The method according to either claim 11 or claim 12 wherein the average particle size is about 15 nanometers.

19. The method according to any one of the preceding claims wherein the method includes a further step prior to step (d), the step comprising mixing a polymer component into the gel, the polymer component being capable of bonding with the gel and particulate material during step (d).

20. The method according to claim 19 wherein the polymer material is either hydrophobic or rendered hydrophobic during step (d).

21. The method according to any one of the preceding claims wherein the method includes a further step prior to step (d), the further step comprising adding a surface modifier to the gel, the surface modifier being capable of increasing the intrinsic chemical hydrophobicity of a hydrophobic surface formed with the modified gel.

22. The method according to claim 21 wherein the surface

modifier further enhances bonding between the particulate material and the gel.

23. The method according to either claim 21 or claim 22 wherein the surface modifier is a compound including one or more hydrophobic groups and one or more condensation cure groups.

24. The method according to claim 23 wherein the one or more hydrophobic groups include one or more of the following groups:
methyl;
ethyl;
vinyl;
trifluoropropyl.

25. The method according to either claim 23 or claim 24 wherein the one or more condensation cure groups include one or more of the following groups:
acetoxy;
enoxy;
oxime;
alkoxy;
amine.

26. The method according to any one of the preceding claims wherein the particulate material comprises a flame-hydrolysed silica powder, and the gel comprises a silicon dioxide gel.

27. The method according to any one of the preceding claims in combination with claim 19 wherein the polymer component comprises polydimethylsiloxane (PDMS).

28. A method of forming a coating on a substrate, comprising the steps of:

- forming a modified gel in accordance with the method of any one of the preceding claims;

- applying the modified gel to the substrate; and
- treating the applied modified gel such that a coating is formed on the substrate, the coating having a surface which is chemically hydrophobic and has a surface roughness which physically enhances the surface hydrophobicity, such that water forms a contact angle of at least 150°.

29. The method according to claim 28 wherein the hydrophobic surface of the coating is such that water forms a contact angle on it of at least 155°.

30. The method according to claim 28 wherein the hydrophobic surface is such that water forms a contact angle on it of at least 160°.

31. The method according to claim 28 wherein the hydrophobic surface is such that water forms a contact angle on it of at least 165°.

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32. The method according to any one of claims 1-31 wherein the modified gel is in the form of a slurry.

33. The method according to any one of claims 28-32 wherein the step of applying the modified gel to the substrate comprises using one of the following techniques:
spin coating;
dip coating; or
spray coating.

34. The method according to any one of claims 28-33 wherein the step of treating the mixture comprises drying the applied modified gel such that a solid coating is formed.

35. The method according to claim 34 wherein the step of drying includes a step of heating the applied modified gel to a temperature which is sufficient to evaporate any solvents.

36. The method according to either claim 34 or claim 35 wherein the step of drying the coating comprises heating the coating to a temperature in the range from 120° to 400°C.

37. A modified gel produced by a method in accordance with any one of claims 1-27.

38. An object having a surface, at least a portion of which is coated with a hydrophobic coating formed from a modified gel made by a method in accordance with any one of claim 1-27.

39. A hydrophobic coating produced by a method in accordance with any one of claims 28-36.

40. An object having a surface, at least a portion of which is coated with a hydrophobic coating produced by a method in accordance with any one of claims 28-36.

41. A method of forming a material capable of being applied to surface, substantially as herein described with reference to the accompanying examples and Figures.

42. A method of forming a coating on a substrate substantially as herein described with reference to the accompanying examples and Figures.